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The Political Economy and Metal Trade in Bronze Age Europe: Understanding Regional Variability in Terms of Comparative Advantages and Articulations

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In the second millennium cal BC, a new metal conquered Europe: the alloy of copper and tin that improved the quality of tools and weapons. This development, we argue, initiated a framework for a new political economy. We explore how a political economy approach may help understand the European Bronze Age by focussing on regional comparative advantages in long-distance trade and resulting bottlenecks in commodity flows. Links existed in commodity chains, where obligated labour and ownership of resources helped mobilize surpluses, thus creating potential for social segments to control the production and flows of critical goods. The political economy of Bronze Age Europe would thus represent a transformation in how would-be leaders mobilized resources to support their political ends. The long-distance trade in metals and other commodities created a shift from local group ownership towards increasingly individual strategies to obtain wealth from macro-regional trade. We construct our argument to make sense of available data, but recognize that our model's primary purpose is to structure future research to test the model.

Keywords: regional variability, metal trade, bottlenecks, social complexity, comparative advantage, political economy

Introduction: The Political Economy of Bronze Age Europe

A political economy perspective on social stratification and centralized power looks at the articulation between a society's economy and institutional structure. Economies are open systems that contain many commodity chains, encompassing steps in production, commodity flows, and consumption. Local societies use economies to meet staple needs, social desires, and political strivings. A broadly integrated regional and macro-regional economy, as seen during the Bronze Age (BA), can emerge when comparative advantages exist in resources and productive knowledge. Local populations typically have imperfect access and knowledge of the many steps involved in commodity chains, and access and knowledge give advantages to certain local producers, traders, warriors, travellers,

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and leaders. A potential can emerge to control material flows and so fuel inequality and power relationships.

Based on a Marxist analysis generalized to pre-modern economies, our approach to prehistory investigates how economic power created a fluid socio-political process (Earle, 1997; Rowlands & Ling, 2013). How was BA society organized? Was it tribal, chiefdoms, or even states? The answer is that it probably included examples of many social formations based on different local articulations with staple and wealth production and flows. Two major paradigms are competing in BA research: one that stresses elite-controlled long-distance trade networks (e.g. Kristiansen & Larsson, 2005; Kristiansen & Earle, 2014), another that stresses local processes and smaller-scale tribal or segmentary interaction (e.g. Harding, 2000, 2013; Kienlin, 2012, in press). Depending on the European areas and archaeological assemblages being considered, both arguments may prove to be true, but to resolve these competing approaches requires systematic data collection. We focus on variability across Europe by outlining commodity chains for metal, and show how different articulations may have created alternative means to establish exclusionary relationships in some areas, but not others.

To understand the BA, we step back briefly to consider the Neolithic. Based on the productivity of different regions, social groups established ownership over local territories marked by burial monuments and ceremonial gathering places. At burial rituals and group ceremonies, local and regional leaders would distinguish themselves and their groups by impressive ceremonies memorialized in built environments. Prestige goods exchange included some early metals and other rare commodities, and trade in these objects increased modestly through the Age (Kristiansen & Earle, 2014). As Renfrew (1984) argued, these were group-oriented chiefdoms, in which individuals were not particularly distinguished, but the seeds of social inequality were already planted.

The shift from the Neolithic to the BA was a profound structural transformation based on a changing political economy (Earle & Kristiansen, 2010). Large-scale trade in metals and other wealth across Europe developed in the BA, because the new metal technology for tin-bronze required copper and tin, two metals smelted from ores that typically derived from different regions, often quite distant from each other (Pare, 2000; O'Brien, 2014). Tin-bronze was used for weapons and tools and for prestige goods and jewellery, and their flows selectively transformed local social institutions. In locations removed from long-distance trade, group ownership of agro-pastoral resources would have continued largely unchanged from Neolithic patterns. However, in areas articulated with prestige goods flows, ownership of metal goods defined elite statuses, marked by displays seen in burials and hoards. In simple terms, the BA witnessed an emergence of social stratification based on control over commodity flows. This new situation is what Renfrew (1984) coined 'individualizing chiefdoms'.

Fundamental to this transformation was the nature of property relationships by which local corporate ownership was individualized and extended over places and things that were critical for emergent macro-regional trade. Looking first at local systems, settlements often continue to have association with inherited property rights in land. In the Carpathian Basin, settlement included a mixture of villages, forts, and tells associated with group cemeteries. Each settlement and associated burial area had a degree of permanence and ceremonial elaboration that materialized the structure of the local corporate group (Earle & Kristiansen, 2010).

Within each community, relationships existed across generations, indicative of inheritance. What was owned? The land surrounding settlements and their cemeteries was most probably associated with local corporate groups and further subdivided along family lines. Critically important, however, ownership came to be extended over key resources linked to metal trade, especially the river routes. Although burials were fairly uniform in content, a small percentage of burials (about 5 per cent) was associated with metal wealth (Vicze, 2011), probably indicative of emergent stratification.

As illustrated by settlements in Scandinavia, Atlantic Europe developed a new pattern of farms and barrows. This landscape probably materialized a new property system based on farms with larger and more long-lasting buildings. These houses often replaced each other in the same location, suggesting inheritance across generations. Associated with farms were barrow cemeteries (Holst et al., 2013). Each barrow marked a single (or occasional double) primary interment. Barrows were often constructed along a ridge, and secondary burials were added. The burial and housing patterns seem to emphasize family lines probably associated with inheritance of land and perhaps title. Ownership was, however, not simply over subsistence lands, but included control over lands that produced local exports (Earle, 2002). Distinguishing the individual, burials contained personal metal weapons and finery obtained through trade; wealth was also deposited in hoards, probably indicating distinction. Across Scandinavia, the amount of wealth in burials and between regions was strikingly differentiated (Earle & Kristiansen, 2010).

An integrating system of trade that stretched across Europe created the comparative advantage of one region over another for export products (Ricardo, 1817). Based on differences in environment, resources, skill, know-how, capital equipment, social organization, market access, etc., comparative advantages emerged reflecting quality or labour value of goods and services (Rowlands & Ling, 2013). The Ricardian 'law' assumes the existence of an integrated economic system, but such systems are, in fact, not universal. They arose in the past, and threshold factors apparently emerged during the BA that created the comparative advantage of different regions and encouraged the development of macro-regional trade. Thus, comparative advantage relates to modes of production in at least two different ways. It defines the horizontal relations between regions and the vertical relations within societies.

Traded commodities in BA Europe included copper, tin, gold, silver, amber, wool, hides, textiles, furs, salt, shells, ivory, glass, and jet, each giving uneven comparative advantages to different regions (Figure 1). For example, the Baltic amber, furs, and hides may have constituted important components of a Nordic comparative advantage. The Alpine region could have focussed on copper and salt, and the Carpathians on precious metals, copper, and wool. In Western Europe, the British Isles could have specialized in supplying tin, copper, and perhaps also gold; Spain, copper and silver, and maybe also tin; Sardinia, copper and silver. In the eastern Mediterranean, Cyprus emerged in the second millennium cal BC as a major producer of high-quality copper and a possible market place for tin imported from Asia (Stöllner et al., 2011). On present evidence, while copper was smelted in the second millennium BC in various places across Europe, tin could only have been obtained from the far west of Europe (Cornwall and western Iberia), or from western Asia (Iran, Kazakhstan, and other localities in this region). There

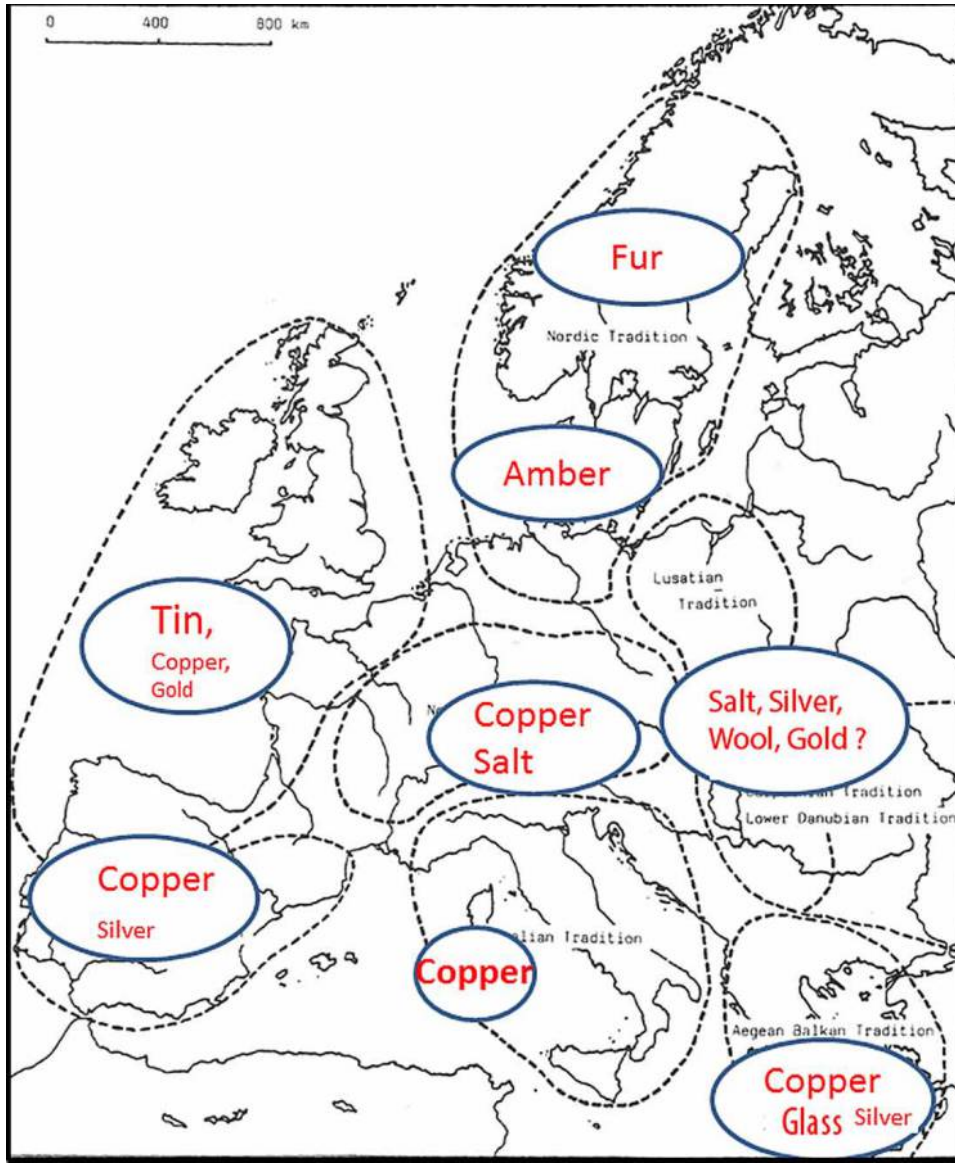

Figure 1. *Schematic overview of the comparative advantages of the different regions of BA Europe proposed here.*

are also tin ores in Central Europe in the Erzgebirge, but so far no evidence of BA exploitation exists (Haustein et al., 2010). We believe that trade in copper and tin, for the ubiquitous bronze inventory of the BA, created the underlying conditions that drew in trade in other commodities and created a vast, integrated trading system.

Metal Deposits and Bronze Age Commodity-Based Trade: Review of the Evidence

In various European regions, deposits of metals were extracted and used in the BA: gold, copper, lead, silver, and tin. The distribution of rich ore deposits, their ease of

access, know-how of smelting, as well as accessibility to trade routes together created regional comparative advantages. As metal use increased, long-distance trading networks formed. We start with the underlying pattern of extraction of copper and tin to understand the economic differentiation of source regions (Figure 2).

Although copper ores are found in many European regions, not all of them were exploited in the BA. In the second millennium BC, large amounts of copper were extracted, for example, in Cyprus, the Alps, the Iberian Peninsula, the British Isles, and Sardinia (Stos-Gale et al., 1998; Hunt-Ortiz, 2003; Höppner et al., 2005; Lo Schiavo et al., 2005; Pernicka, 2010; O'Brien, 2014). Recent provenance studies suggest that periodical shifts took place in regional production of copper as major supply zones succeeded one another (Rohl & Needham, 1998; Ottaway & Roberts, 2008; Timberlake, 2009; Pernicka, 2010; Jung & Mehofer, 2013; Ling et al., 2014).

In the eastern Mediterranean, third millennium BC copper smelting sites were found on Kythnos in the Cyclades (Stos-Gale, 1989) and on Crete (Betancourt, 2006). Although no evidence exist for who controlled copper extraction in the Cyclades, the palaces on Crete were probably in control of the metal supplies. In the second millennium BC, Cyprus was a major centre of copper production. The copper was smelted in the mountains, as is indicated by numerous slag heaps, but trade in copper (and possibly imported tin) was likely organized and controlled by coastal towns (Kassianidou, 2013).

The Iberian Peninsula is another large BA producer of copper in the Mediterranean, and mines are found both in the

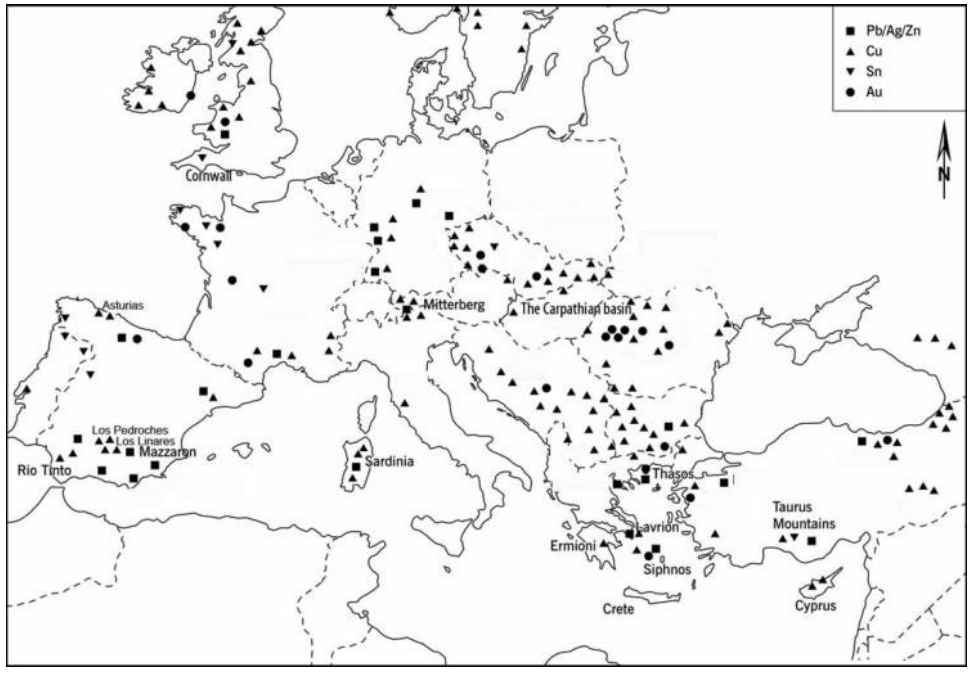

Figure 2. *Map showing the major copper, tin, and silver deposits in Europe and the mining areas mentioned in the text.*

south, for example, in the Sierra Morena (Hunt-Ortiz, 2003), and in the north, for example, in the Asturias on the Atlantic Fringe (Huelga-Suarez et al., 2014). While fortified sites may have played a role in distributing metals during the Argaric period, copper extraction was probably carried out in the mountains; however, control by local elites is not apparent (Lull et al., 2014).

Early on, many occurrences of copper in the Alpine region were exploited, but only a few appear to have dominated. Large-scale copper mining took place in Mitterberg, Austria, probably providing metal to a large supply region including the Carpathian Basin via the Danube (Niederschlag et al., 2003; Krause, 2009; Pernicka, 2010). Although the abundant and proficient metalwork in the Carpathian Basin might suggest local extraction (Liversage, 1994), at present no conclusive evidence exists for BA copper mining there (Bartelheim, 2009; Boroffka, 2009), although copper, gold, and silver might have been extracted (see Drews & Pernicka, 2011; Stos-Gale, 2014). In the UK and Ireland, copper mines operated first and foremost from 2200 to 1700 cal BC and into the Middle Bronze Age (MBA), even if some remained active throughout the BA (Timberlake, 2009). From 1400 cal BC onwards, lead isotope evidence suggests an influx of copper to the British Isles from the western Mediterranean (Rohl & Needham, 1998: 182; cf. Needham et al., 2013).

Assessments of the scale of BA copper production vary widely, from ten or more tonnes annually for the Pongau-Mitterberg region in Austria (Zschocke & Preuschen, 1932; Eibner, 1993) to a total production estimate for all known BA mines in Britain and Ireland of just over 50 tonnes (Timberlake, 2009; cf. O'Brien, 2014). Given that metal rapidly replaced stone for the making of axes at the beginning of the BA and that the use of bronze became prevalent in the manufacture of weapon and tool types during the course of the second millennium cal BC (O'Brien, 1999; Pare, 2000; Butler, 2009), the lower estimates seem unlikely. In terms of higher assessments, a discrepancy exists between estimated production output and the amount of contemporary metalwork that has been found (O'Brien, 2014), although it must be expected that only a fraction of bronze objects has been recovered (Taylor, 1999). Based on metalwork found in graves and hoards coupled with demographic figures, northern Central Europe and southern Scandinavia had an estimated yearly metal consumption of *c.* 2.5–4 tonnes (cf. Kristiansen, 1985; Rassmann, 2011; Holst et al., 2013).

These estimates seem much too low for the Eastern Mediterranean, considering that the ship of Uluburun dated to the fourteenth century cal BC sank off the coast of southwestern Turkey carrying 10 tonnes of Cypriot copper and 2 tonnes of tin (Pulak, 1998). The Mycenaean tablets and Near Eastern archives often recorded substantial metal supplies. For example, one tablet from LBA (Late Bronze Age) Knossos recorded sixty copper ingots weighing 1562 kg from the palace storerooms (Michailidou, 2001). Dated to Late Minoan IA (sixteenth century cal BC)[1], the cache of ox-hide ingots in the Aya Triadha palace on Crete weighed over a half-tonne. Throughout the LBA, a steady supply of copper (and tin) existed in the Aegean, some from local sources (Lavrion), some from Cyprus, and small amounts from more distant sources (Stos-Gale,

[1]Late Minoan IA is the right nomenclature; Roman numeral I and capital A indicating that it is the first sub-phase of the Late Minoan chronology (cf. Manning, S. 2010. Chronology and Terminology. In: E. Cline, ed. The Oxford Handbook of the Bronze Age Aegean. Oxford: Oxford University Press, pp. 11-28).

2000: 65). The large deposition of bronze in Aegean graves shows that no necessity existed to reuse metal. These metal figures should be seen as absolute minima as they do not consider tool wear and tear or normal accidental losses. Lead isotope and elemental analysis furthermore indicate that large-scale metal recycling was unlikely (cf. Jung & Mehofer, 2013; Ling et al., 2014; Melheim, 2015a). Copper was apparently already an important commodity by the Early Bronze Age (EBA) (cf. Pare, 2000).

Tin deposits in Europe are much less common than copper. Presently, circumstantial evidence exists for BA exploitation of tin deposits in Britain (Penhallurick, 1986: 168–221; Rohl & Needham, 1998; Harding, 2000: 201; Timberlake, 2009) and in Spain (Hunt-Ortiz, 2003). Some copper–tin slag on the Iberian Peninsula also suggests a co-smelting of copper and tin for bronze (Gómez Ramos, 1999). In the eastern Mediterranean, tin-bronzes occur early in the third millennium BC, for example, during the Early Minoan I–II on Crete (Stos-Gale, 2001; Gale & Stos-Gale, 2007). Tin used in the Aegean was probably obtained from Asian or Anatolian sources (Yener et al., 1989).

Although tin was produced separately, it could be traded with copper, as documented by fourteenth- and thirteenth-century BC cargoes from two eastern Mediterranean shipwrecks: Uluburun and Gelidonya, both of which carried copper ingots from Cypriot ores and ingots of tin from quite different, but so far unidentified sources (Gale & Stos-Gale, 2005; Stos, 2009).

Although copper and other valuable ores occur in many places, the ability and skill to extract the metal differed from region to region. For example, the people of modern Sweden and Norway imported copper during the BA despite local deposits. According to Childe (1930), metal production was the first crucial step towards permanent division of labour and a market economy. In this paper, we argue that this is true only in general terms, because the emerging 'international' (macro-regional) system of trade in the BA became increasingly based on the comparative advantage of commodity producers in different regions. Each commodity can be described as a chain of producers with differential access to materials and knowledge and trade with the potential for extraction from the new BA political economy.

We conclude that during the BA, fairly large-scale production and consumption of metal across Europe created regional comparative advantages and a corresponding network of trade, probably of substantial volume. The gearing up of amber, wool, and other production for export allowed many regions to participate in what became an integrated trading system.

Commodity Chains: Review of the Evidence

A commodity chain involves the linkages among resource extraction, processing, fabrication, transportation, exchange, and consumption for a particular product. For long-distance trade in regionally specialized goods, radically longer and more complex commodity chains emerged and became interdependent. Bottlenecks are constriction points in commodity chains, which offer the opportunity to limit access by creating ownership over resources, technologies, or knowledge (Earle, 2002). We discuss how bottlenecks emerged in BA metal flows to offer emerging elites opportunities to extract surpluses in the new political economy (Figure 3).

The first step in commodity chains for metal is mining and extraction of metal from ores. Mining and copper smelting

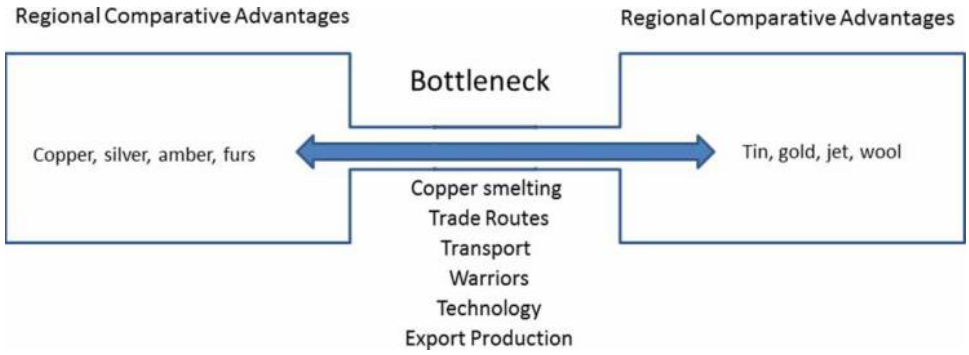

Figure 3. *Model of interplay between bottlenecks (constriction points) and regional resources (comparative advantages). BA elites benefited from controlling the bottlenecks of commodity chains: know-how (smelting and metalworking), transportation (routes, means of transportation, and defence), and local exchange.*

activities were not necessary under elite control or associated with development of unusual social complexity. Sources could have been open assets, owned by local groups, or by miners and metallurgists themselves, or perhaps even by traders. On the other hand, in the Aegean during the LBA, copper extraction seems to be limited to the Lavrion mines in Attica (Gale et al., 2009), which could have been under supervision by Mycenaean palaces. Lead isotope analysis of several thousand copper-based artefacts from the Mediterranean show that copper (as well as lead and silver) from Lavrion predominates amongst BA Aegean metals; however, metals from these sources are rarely found elsewhere (Stos-Gale, 2000). The leading role of the Mycenaean palaces in metal trade is visible in the inventory of the shaft graves in Mycenae, where a large amount of imported gold was deposited together with silver vessels made locally, but from silver most likely imported from Transylvania (Stos-Gale, 2014).

In the Alps during the early second millennium cal BC, no dominant mining centre existed, so the copper production did not result in a local advantage of one group over others, and the society around the Alpine mines remained largely undifferentiated (Shennan, 1995; Kienlin & Stöllner, 2009). Even in the Mitterberg area with its substantial lodes, evidence is lacking for elite control. Although suggestive of a property system, fortified mining settlements, like St Veit Klinglberg in the Salzach Valley, were small, apparently getting ore from many lodes (Shennan, 1998; Stöllner, 2010, 2012). Only when production became large-scale did control over mining offer an effective bottleneck. Copper smelting in the BA required highly specialized knowledge that might have been a closely guarded secret, and smelting may therefore have provided a bottleneck in the commodity chain.

The second potential bottleneck was limited alternative transport routes for the metals and other commodities that constricted flows. Early in the BA, Bell Beaker social groups appeared to have established water-based trade for metal and other commodities (Cunliffe, 2008; Pilar, 2008; Heyd, 2013), but multiple alternative routes of trade at this time probably limited potential bottlenecks. Found along the Atlantic fringe from Spain to Denmark, in the west Mediterranean and east to Sicily, and along the rivers deep into central Europe, Bell Beaker settlements are associated with

some of the earliest metal objects and metalworking (Pilar, 2008; Heyd, 2013).

Recent research indicates that at least two major BA systems of metal flow seem to have connected northern and southern Europe: (1) riverine routes (Central European), and (2) maritime routes (Atlantic/Mediterranean) (Ling et al., 2014). Interaction between these flows created more or less integrated trade throughout Europe. Each set of routes had rather distinct bottlenecks that would have served differently for emergent social hierarchies (Figure 4).

The riverine routes channelled metals and other commodities along waterways between north, central, and southern Europe. In situations where large rivers provided particularly effective, high-volume trade routes, settled groups could have constricted flows and extracted payments for safe passage. Childe (1929) originally stressed the importance of rivers, especially the Danube, as transportation routes for commodities. Along the Danube's bluffs in Hungary and other major waterways, chains of fortified tells arose in the EBA and MBA (Gogâltan, 2008; Uhnér, 2010; Szeverényi & Kulcsár, 2012), and each fortified settlement probably extended property rights over the rivers. Along the Hungarian rivers and their immediate hinterland, metal finds occur in major hoards (Mozsolics, 1967; Hansen, 2005). Similarly contemporary fortified settlements and hoards occurred

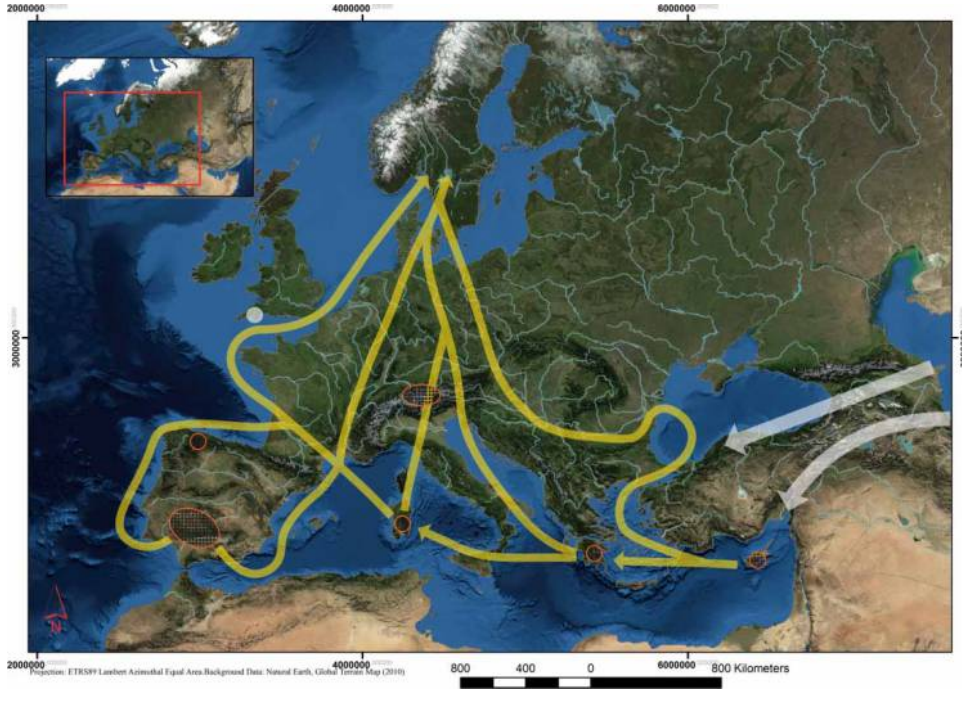

Figure 4. *A hypothetical outline of European copper and tin routes supplying Scandinavia during the BA. Areas marked in black denote copper bearing regions, matching metal signatures in Scandinavian bronze artefacts (Ling et al. 2014). The tin bearing region in Cornwall is marked with silver, while the silver arrows signify an eastern influx of tin. Note: the arrows and directions on this map should not be read literary as the only routes in operation between southern and northern Europe during the BA. It is a model that indicates directional flows.*

next to the waterways further north in Slovakia (Bátora, 2009). Clusters of EBA hoards also existed at mouths of Alpine rivers (Krause & Pernicka, 1998; Krause, 2003), suggesting that trans-shipment places created effective bottlenecks. We propose that the fortified tells along the Danube and other transport routes acted as central places for small-scale chiefdoms, as exemplified in the Benta Valley, Hungary (Earle & Kristiansen, 2010). Similar chiefdoms probably arose at mountain passes, river crossings, and other constriction points, where moving metal and other wealth would then have required payments for safe passage through each local polity.

Copper from the Alpine region moved to Scandinavia probably following the rivers Oder, Elbe, and Vistula to the shores of the Baltic Sea and transhipped across the Baltic to Scandinavia. Additionally, copper from the eastern Mediterranean (Cyprus) may have been transported northwards through Eastern Europe via the Carpathian Basin, and some of the metal from the western Mediterranean may have moved through a central European overland/riverine system (Ling et al., 2014). Geo-chemical analyses (Pernicka, 2010) indicate that some metal found in the Carpathian Basin had sources in the Alps, probably coming by overland and river routes to the Danube and its tributaries.

When analysing water-based transport, the number of alternative routes is critical to define potential bottlenecks. The more options (of equivalent cost) that were available, the less constricted was a bottleneck. The western maritime routes channelled metals in two directions from the copper mines of Spain and Sardinia in the south and copper and tin from British Isles and Ireland. These routes were probably established by Maritime Bell Beaker groups in the third millennium BC and then later expanded and used by Scandinavian maritime chiefdoms from *c.* 1600 cal BC (Rowlands & Ling, 2013). Although evidence for trade along the maritime routes remains preliminary, much of the metal was probably moved by sea to Scandinavia via the British Isles (Ling et al., 2014). Nordic bronze swords and other MBA (1500–1300 cal BC) artefacts share isotopic signatures with British swords that in turn seem to be consistent with copper ores from western Mediterranean. Tin is key to understanding the Atlantic network in the BA, and a tin ingot found in Sweden has lead isotope ratios consistent with Cornwall ores (Ling et al., 2014). Western Mediterranean copper could have been transported either via the south coast of France through the Garonne axis to the French Atlantic coast and northwards to Brittany, the British Isles, and Scandinavia, or via southern Spain and Portugal and Galicia northwards across the Celtic Sea to Brittany, the British Isles, and Scandinavia.

For maritime connections, such as between the British Isles and Scandinavia, currents make sea transport more reliable and lower cost. Sea currents connecting the British Isles and western Scandinavia were probably used already in the Neolithic (Figure 5). Judging from find distributions, Bell Beaker maritime ventures followed the Atlantic fringe, a trail that was crucial earlier for the spread of megaliths and stone-axe trade (Cunliffe, 2001; Pilar, 2008). Maritime groups evidently used sea currents to minimize costs; the currents from the British Isles to Sweden's west coast hit the densest area of figurative rock art and monumental burial cairns that document trading (see later discussion).

With maritime routes, bottlenecks were quite different from riverine routes. Open-sea trade is almost uncontrollable, because routes could easily shift to avoid

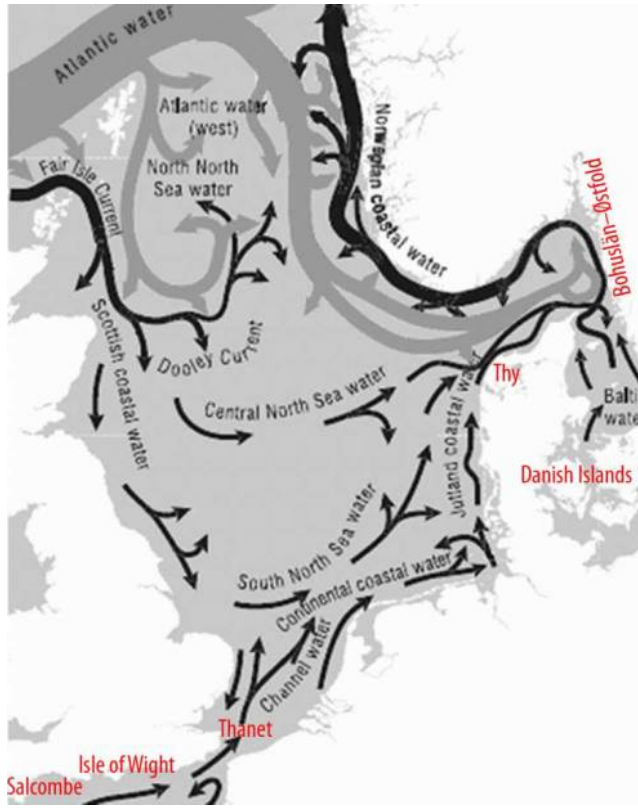

Figure 5. *Sea currents connecting the waterscapes of the British Isles and western Scandinavia were known and already used in the Neolithic. Strategically positioned islands or natural harbours facilitated by the system of currents were used for maritime trade and interaction. Based on a schematic map of the sea currents in the North Sea.*
After Turrell (1992)

payments. Ability for landed groups to benefit from maritime trade would have depended on possible ways in which routes could be channelled. Equivalent to the settled chiefdoms on riverine routes, piracy may have taken place along routes where alternative sea paths were costly or dangerous. In terms of other bottlenecks in maritime routes, landed chiefdoms could have attracted traders to particular ports of call near prominent headlands that needed to be rounded or on strategically positioned islands and in natural harbours. The peninsula of Brittany and its islands, the Isle of Scilly, Isle of Wight, Plymouth, Southampton, and Salcombe on the other side of the Channel, as well as the Thames estuary, may have been crucial for trade (cf. McGrail, 1993; Needham, 2009; Needham et al., 2013). The most concrete example of this suggestion is new evidence from strontium- and oxygen-isotope analysis of skeletal material from Thanet, which show that Scandinavians and groups from the Western Mediterranean interacted with locals during the LBA (McKinley et al., 2013). Safe harbours along the shores of Atlantic Europe were obvious natural bottlenecks; by the Iron Age, states made major investments in port facilities here. In the BA, capital improvements to harbours were

probably limited, with perhaps a few Aegean exceptions.

Restriction points could also have existed at well-placed locations for gathering traders and transhipping goods into interiors or by secondary routes. Emergent market places could be augmented by local metal production and ritual places linked to metal and seafaring. In Scandinavia, metalworking at transhipment places apparently acted as such points of potential control. Some larger workshops were found at favourable seashore locations connecting waterways to the interior and landing places for ships. At these locations, semi-finished metal objects and ingots were produced for distribution to the interior (Melheim, 2015a). In the Nordic LBA (1100–500 cal BC), strategically situated workshops along the coastal face of Scandinavia and the Baltic, including Asva at the island of Saareema in Estonia (Sperling, 2014), Hallunda in Mälaren, Sweden (Jaanusson, 1981), and Hunn in south-eastern Norway (Melheim et al., 2015a) show centralized bronze and pottery production, access to raw metals, and strong connections to other parts of the North Sea and Baltic seascapes. Subsequently, some of these locations developed into urbanized and/or fortified centres dependent on trade.

As discussed below, people shifted production towards exports as a means to obtain metal. At coastal market places, local chiefs could control contact between external traders and landed agents, as on the British coasts. With the development of regional specialized products available at coastal markets, the British Isles could have acted as a transit zone for both domestic and foreign copper as well as providing local tin (Rowlands & Ling, 2013). The availability of tin on the British Isles would thus have offered a competitive advantage that would have effectively linked them into the trade systems.

Third among the major bottlenecks in BA metal commodity chains was transport technology. The ownership of ships became, we believe, the most effective means to control the political economy along the Atlantic fringe and in the Mediterranean. The use of water transport created a need for capital investment, specialized sailors, and warriors to man and protect the boats. During the BA in the eastern Mediterranean, maritime technology developed considerably earlier (McGrail, 2001) and was on a level of sophistication incomparable to Atlantic and northern Europe. However, complex sewn-plank boats capable of long-distance sea journeys had already been developed in the EBA in the British Isles (McGrail, 1993; Cunliffe, 2001). These technologically sophisticated, sea-worthy crafts were not acquired overnight (Cunliffe, 2001). Based on the distribution of settlements along the European waterways, maritime Bell Beakers had already created open-sea boat technology during the third millennium (Pilar, 2008). Although no Bell Beaker boats have been found, they must have been adequate to establish regular interregional connections along the coasts and rivers of northern Europe and across the Channel (Cunliffe, 2008).

Scandinavians participated actively in long-distance maritime enterprises during the BA. Today, most scholars agree that prehistoric boat finds and rock art document a long boat-building tradition in Scandinavia (Crumlin-Pedersen, 2003; Kaul, 2003; Ling, 2008) (Figure 6). The proportions of the hull, stem, and prows on the rock-art ships correspond closely with the sewn and planked built boat from Hjortspring dated to 350 BC. The similarities between the Hjortspring boat and rock-art ship depictions show a continuous shipbuilding tradition in Scandinavia from the EBA (1700–1100 cal BC), to the Pre-Roman Iron Age (500–200 cal BC)

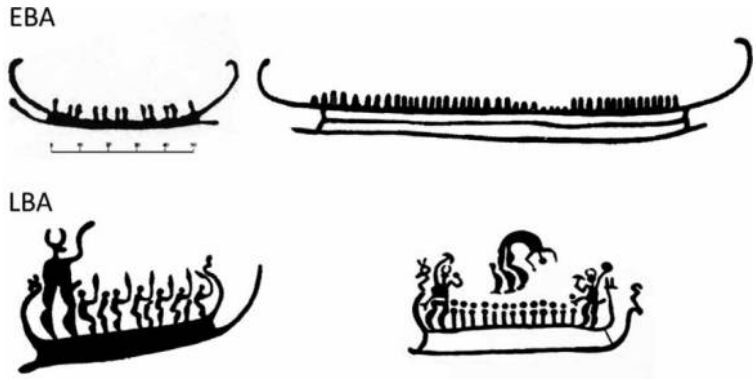

Figure 6. *Rock art from Bohuslän, western Sweden, displaying war canoes from the Early and Late Bronze Age respectively. The average crew was six to fourteen people, but larger ships could hold up to fifty paddling warriors.*

(Crumlin-Pedersen, 2003; Ling, 2008). The reconstruction of the Hjortspring boat demonstrates that it was sea-worthy and effective. With a trained crew of twenty-two people, it could travel at sustained speeds of 4 knots and up to 100 km per day, carrying a cargo of over 700 kg (Crumlin-Pedersen, 2003). Following the North Sea coast and including stops to rest and resupply, such a boat could reach the west coast of Sweden from the Isle of Thanet in less than 2 weeks.

The potential cost advantage of the maritime route apparently triggered the formation of improved maritime technologies and institutions so as to enter macro-regional networks. The steep increase in metalwork of local manufacture in south Scandinavia after 1600 BC (Vandkilde, 1996) indicates that these societies engaged with commercialized trade for metal. Maritime trade, as an economic driver, is illustrated by wealth distribution and social stratification in the Scandinavian Bronze Age (Larsson, 1986). On coastal rock panels from Sweden and Norway, boat motifs show commonly six to fourteen paddling warriors/traders (Ling, 2008) (Figure 7). A maritime lifestyle appeared in BA Scandinavian rock art, ship-shaped graves and ship engravings on bronzes, and a maritime ideology became a cornerstone for the Nordic sphere.

In contrast to the usual association of barrows with agro-pastoral land, on the rocky hill shores in Sweden and Norway, stone burial cairns stand overlooking the sea and marking sea routes. It is easy to imagine that these were the resting places for travelling warriors, the owners of the ships. Furthermore, during the Nordic LBA (1100–500 cal BC), while metal wealth became generally more evenly spread through Scandinavia, a few locations on the Danish Islands (e.g. Lusehøj and Voldtofte on Fünen) become centres of wealth and probably social power (Kristiansen, 1998). Cost advantages of the maritime trade route created the comparative advantage for Scandinavian maritime chiefdoms based on specialized boat building and knowledge, strategic locations with respect to trade, and warriors to protect shipping. Maritime chiefdoms could have existed in other areas as well, such as the Aegean or the British Isles, but more evidence is needed.

Fourth among the major bottlenecks would have been the defence of transport

Figure 7. *Rock art panel at Fossum in Tanum, Sweden, displaying typical features of BA warriorhood.* Ink tracing by G. Milstreu, Tanums Hällristningsmuseum Underslös, SHFA

routes and commodities. In a world without large states able to guarantee safe trade, warriors must have defended the production, movement, and storage of wealth and acted as settled raiders and pirates to siphon off wealth along routes (Kristiansen & Larsson, 2005; Vandkilde, 2006, 2007). Warriors would easily have shifted from one role to another as opportunities for patronage and independent raiding presented themselves (Earle, 1997). A telling analogue is the Viking longboats pulling up on the beaches of England, glad to trade if noticed or to raid if surprises were in their favour (Figure 7). The importance of warriors created a specialist cadre with equipment, training, and social standing. In Scandinavia, for example, individual burials equipped with weapons document the importance of such warriors (Kristiansen, 1985; Vandkilde, 2006).

Fifth among bottlenecks was fabrication of metal artefacts that required highly specialized knowledge and rituals held by only a few craftspeople. Although the introduction of bronze metalworking in the late third millennium BC in northern Europe brought in an exotic technology that only a few craftsmen held, soon metalworking skills were more commonly spread (Kuijpers, 2012; Melheim, 2015b). For instance, the distribution of bronze working tools in Scandinavia by 2000–1700 cal BC reflects a broadening technological knowledge that vitiated the production bottleneck. From 1600 cal BC, two kinds of socially significant metal artefacts were characteristic: the weapons and jewellery associated with elites, and practical working tools (flanged axes and later socketed axes and palstaves) associated with woodworking and other craftsmen (Vandkilde, 1996). Thus, EBA elites in Scandinavia may have promoted an overall consumption of metal that they alone could provide based on their ability to control seafaring and access to the metal networks. Moreover, by supporting highly skilled specialists, chiefs could control production and distribution of specialty items for warriors, chiefs, and ritual specialists (Herner, 1989; Earle, 2002).

In the Late Nordic Bronze Age, casting occurred at many settlements but also in

specialized workshops and ritualized settings like cult houses (Goldhahn, 2013; Melheim, 2015a). To retain some control, however, chiefs emphasized the use of more elaborate ceremonies and dress with new bronze forms (lurs, helmets, and specialty equipment) that were technically complicated to fabricate (Kristiansen, 1998). The elaboration of forms thus continued to require highly gifted metal workers, whom elites could control through sponsorship (Barber, 2003). By controlling the production of weapons and wealth, chiefs could organize centrally, to some measure, the warriors using the weapons, those claiming special status through the display of metal finery, and ritual specialists using special paraphernalia.

Sixth among bottlenecks in BA metal trade chains were local exports provided in exchange for metal goods. Commodities that served as exports during the BA included agro-pastoral products (cattle, oxen, horses, hides, milk/cheese, sheep, and wool), special materials (such as amber, jet, spondylus, and soapstone), craft items (such as weapons or jewellery and serving vessels), and products from wild animals (such as furs, skins, and antler), as well as timber and woodwork and probably slaves (Earle & Kristiansen, 2010; Uhnér, 2010). The ties between Scandinavia, Atlantic Europe, and the western Mediterranean world could be seen in light of a prestige goods system based on metals from the south and a wide range of products that would have given regional advantages in export (Rowlands & Ling, 2013). Based on the comparative advantages of each export, different opportunities existed for control that had contrasting outcomes for development. Most basic would have been local access to resource locations for animal or mineral products with macro-regional demand.

To exemplify, chiefdoms emerged in Jutland during the EBA based on regional competitive advantages for exporting amber, flint daggers and sickles, and cattle and their hides. The initial long-distance trade in northern Jutland apparently was linked to Bell Beaker groups involved in local export production of amber and flint (Pilar, 2008). The Baltic amber constitutes the best-documented Scandinavian material traded southwards for copper (Kaul, 2013). Amber was much used as a local prestige good in Scandinavia, but by 2000 cal BC, only raw amber appears there routinely. After 1600 cal BC, amber entered the hands of chiefly traders, and it occurs in elaborate graves along with bronze and other prestige objects (Goldhahn, 2013). At this time, amber circulated widely in European prestige networks in the ore-bearing districts that have been hypothesized to be the source of copper to Scandinavia (Ling et al., 2014); a macro-regional demand for the magic of amber apparently created the Baltic export throughout Europe (Sherratt, 1993). Amber collection was a simple affair in Jutland where it is recovered along the beaches after storms and difficult to regulate directly; its use as an export product, however, would have been possible to control through access to ships and maritime skills.

The emergent specialization in southern Scandinavia in specific commodities for export can be seen in the late third millennium BC with flint (Apel, 2001). In Thy (Jutland) from 1500 to 1100 cal BC, cattle, amber, and maritime skills provided the region with considerable metal wealth (Earle, 2002; Earle & Kristiansen, 2010). Chiefly elites apparently asserted ownership of pasturelands by the construction of individual burial mounds positioned high on the best grasslands. Social stratification was expressed in the size of burial mounds, the richness of deposited wealth, and the size of houses (Holst et al., 2013). Another example of secondary animal

products for trade comes from the MBA Benta Valley, Hungary. Excavated animal bones from the tell settlement above the Danube document a shift from meat to milk and wool production in cattle and sheep (Vretemark, 2010).

Many European regions were probably able to develop comparative advantages in productive processes and particular products such as mining, amber, animal herding, or salt extraction (Rowlands & Ling, 2013; Uhnér, 2014). Some regions, however, would have been without a comparative advantage in internationally desired commodities, and, like regions away from controllable routes, they would have remained isolated from opportunities to trade.

We conclude that the BA development of European trade in metal and other special commodities created many long commodity chains and along these chains were multiple points of potential control. These bottlenecks were unevenly spread and variable in their potential for enrichment. Most important appears to have been control over the actual routes and the means of transport, although other bottlenecks were certainly important locally.

A Political Economy Model for the Bronze Age

We propose a model for the BA political economy based on comparative advantages of different regions, long-distance trade, alternative bottlenecks in flows, and emergent social stratification and power relations. The role of models in archaeology is to generate testable hypotheses that help target required data for future research. Our model is not a synthesis, and so references are limited only to key theoretical formulations; rather, it suggests a research agenda to investigate BA Europe comparatively. Statements are made as assertion without all of the 'possibly', 'probably', and 'likely' modifiers that the reader should take for granted.

Comparative advantages of European regions emerged from many interacting production and trading specializations. The natural pattern of ore sources and knowledge of smelting created the most basic regional specializations, but corresponding development of other regional specializations, such as in secondary animal products and maritime trading, were developed to engage in the long-distance trade that prefigured the later development of world systems. Ownership of local resources was critical, but ownership of boats became an effective bottleneck in commodity chains. The comparative advantage of the north, for example, was based first on key local goods, but its social take off was linked to new boat technology and maritime skills (Earle & Kristiansen, 2010). The Danish isles were well positioned to organize long-distance maritime sea, river, and land ventures based on metal flows through the riverine routes of the Oder and Vistula and overland routes from Central Europe to the Baltic and North Sea. The northern coasts of Sweden and Norway provided wood for sea-going vessels and specialized maritime crews. The Scandinavian world held a strong warrior ethos, and these warriors could protect and take part in long-distance trade. And the increasing metal availability served both to arm warriors and to provide woodworking tools for the plank-built boats, thus contributing to a technological 'triangulation'.

Regionally special products and services helped create market-like trade with local export producers, 'international' traders, and others. To attract the traders required particular gathering places. Several distinct, but closely related, processes created the dynamic political and economic forces of competition and collaboration across

Europe, in which some locales rapidly emerged and often fell from dominances as trading conditions changed. To understand contrasting BA institutions and degrees of stratification and power relationships requires an understanding of how different locales were articulated with the ever-changing political economy. We identify three key processes.

The first process involved controlling routes of trade to siphon off wealth by local polities. Ownership of local resources was always critical for differential access to wealth from trade. Additionally, all routes were not created equal in terms of volume and constriction. Across land, routes could only be controlled at movement bottlenecks, such as mountain passes and river/marshland crossings. Because of lower overall costs for transport, water routes would have become favoured for the movement of higher volume goods such as metals. BA water routes included both major rivers and open oceans. Movement along the larger rivers would have been easily controlled by positioning fortified settlement where passage could have been restricted and tariffs extracted. Controlling markets or owning resources used as exports offered additional bottlenecks. We call these 'landed chiefdoms' based on ownership over trading points. These chiefdoms tended to be fairly small and repetitive, with many polities lining up along major trade routes and at key route junctures.

The second process would have involved the development of boat technology. As competitive advantages of open ocean trade increased, a strong advantage would come to those with better boats, able to navigate successfully under unpredictable conditions, able to carry larger cargos, and able to hold more specialized mariners and warriors to protect cargos. As the size and complexity of boats increased during the BA, the ability to fund their construction and distant voyaging would have provided a new bottleneck based on ship ownership. This would have favoured what we call the 'trading chiefdoms' of Scandinavia and perhaps elsewhere. Similar patterns were likely contributing factors to the emergence of Aegean city-states. These chiefdoms formed networks that extend across distances, intertwined by competition and cooperation.

The third process would have involved the increasing importance of specialized personnel, including warriors, craftsmen, and priests, attached to leaders. These specialists were critical to power strategies. Warriors existed back into the Neolithic certainly, but specialist warriors took on increasingly important roles to defend land rights over productive resources and over choke points in trade routes, to defend accumulated wealth, and to raid externally for wealth. Warriors effectively tightened constriction at each bottleneck, at the same time that their use of metal for weapons and personal display increased the value of metal wealth that they helped monopolize. Similarly, with special knowledge and access to metal, craftsmen could produce distinctive and effective weapons and finery for their chiefs and warriors. To the degree that the specialists were few in number and possessing critical esoteric knowledge, production was also an effective bottleneck. And then there was the importance of religious specialists involved especially at moments of risk and mystery. Voyaging and metal-related rituals infused the BA world. Leaders relied on attached specialists such as warriors, craftsmen, and priests involved in extending and augmenting the power of the chiefs.

The growth of the transregional long-distance trade in wealth, especially metals, during the BA transformed the political economy and institutional formation of societies across Europe. Critically important were the complex commodity chains

for wealth that offered opportunities for control at specific bottlenecks, where flows could be siphoned off for local uses. We imagine a mosaic of political institutions spread across Europe, each developing and collapsing according to successes and failures articulating with the trade between regions. The range and kind of societies were highly variable, in some locations essentially egalitarian, in some, small-scale chiefdoms, and in some (especially the Aegean), complex chiefdoms and states. A political economy perspective offers a useful way to understand change and variability in the Eurasian BA. Dynamic and changing systems of power would have mapped on systems of articulations and investment in the trading economy, warrior might, and local religious ideology. Although local societies shared cultural elements and interaction across broad regions of Eurasia, the specificity of their local economies and articulations with the macro-regional trade would have created manifestly specific cultural formations with distinctly local institutions of power relationships.

Based on the framework of our model for the BA, we propose that future work should analyse a wide variety of micro-regions across Europe to evaluate variation in the structure of bottlenecks in commodity trade and production and how they partly determined variability in the structure of political and wealth inequalities. We anticipate that different political formations ranging from relatively egalitarian villages to chiefdoms to states will correspond with manifest opportunities for control and wealth mobilization in the changing BA political economy.

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L'économie politique et le commerce des métaux en Europe pendant l'Âge du Bronze: comprendre la variabilité régionale en termes d'avantages comparatifs et linkages

Au cours du 2e millénaire av. J.-C. un nouveau métal conquérait l'Europe: l'alliage du cuivre et de l'étain, qui améliorait la qualité des outils et des armes. Nous soutenons ici que ce développement instaurait un cadre pour une nouvelle économie politique et nous examinons comment une approche fondée sur l'économie politique peut nous permettre de mieux comprendre l'Âge du Bronze européen, en mettant l'accent sur les avantages comparatifs régionaux lors des échanges à longue distance et sur les goulets d'étranglement des flux de marchandises qui en résultent. Il existait des liens dans les filières des produits de base, où le travail forcé et la possession des ressources aidaient à réaliser des excédents, permettant ainsi à des segments de la société de contrôler la production et les flux de produits essentiels. L'économie politique de l'Europe pendant l'Âge du Bronze décrirait donc un changement dans la

manière avec laquelle des leaders potentiels mobilisaient des ressources pour soutenir leurs fins politiques. Les échanges à longue distance de métaux et autres marchandises ont déclenché un changement allant de la propriété collective locale vers des stratégies de plus en plus individuelles afin de produire de la richesse à partir du commerce macro-régional. Avec nos arguments nous cherchons à interpréter les données disponibles, mais nous admettons que le principal objectif de notre modèle est de structurer la recherche future afin de pouvoir le mettre à l'épreuve. Translation by Isabelle Gerges

Mots-clés: variabilité régionale, commerce du métal, goulets d'étranglement, complexité sociale, avantage comparatif, économie politique

Die politische Ökonomie und Metallhandel im bronzezeitlichen Europa: Zum Verständnis regionaler Variabilität im Sinne von vergleichende Nutzeffekten und Zusammenhängen

Im zweiten Jahrtausend v. Chr. trat ein neues Metall seinen Siegeszug durch Europa an: die Legierung von Kupfer und Zinn, die die Qualität von Werkzeugen und Waffen verbesserte. Diese Entwicklung, so vermuten wir, stieß die Entwicklung eines Netzwerkes für eine neue politische Ökonomie an. Wir untersuchen, wie der Ansatz der politischen Ökonomie dabei helfen kann, unter besonderer Berücksichtigung regionaler vergleichender Nutzeffekte beim Fernhandel und daraus resultierender Engpässe bei Warenströmen die europäische Bronzezeit zu verstehen. Es existierten Verbindungen bei den Güterketten, bei denen Arbeitsverpflichtungen und Eigentum an den Ressourcen dabei halfen, Überschuss zu erwirtschaften – und dadurch ein Potential für soziale Segmentierung schufen, das die Kontrolle der Produktion und Verteilung von wesentlichen Gütern gewährleistete. Die politische Ökonomie der europäischen Bronzezeit spiegelt demnach einen Übergang wider, bei dem die angehenden Oberhäupter Ressourcen mobilisierten, um ihre politischen Ziele zu unterstützen. Der Fernhandel von Metallen und anderen Waren ermöglichte einen Sprung vom lokalen Gruppenbesitz hin zu vermehrt individuellen Strategien, um aus dem makroregionalen Handel Reichtum zu erzielen. Wir entwickeln unsere Beweisführung, um bereits vorhandene Daten deuten zu können, sind uns jedoch bewusst, dass das vorrangige Ziel unseres Modells die Struktur zukünftiger Forschung ist, um seine Gültigkeit zu testen. Translation by Heiner Schwarzberg

Stichworte: regionale Variabilität, Metallhandel, Engpässe, soziale Komplexität, vergleichende Nutzeffekte, politische Ökonomie